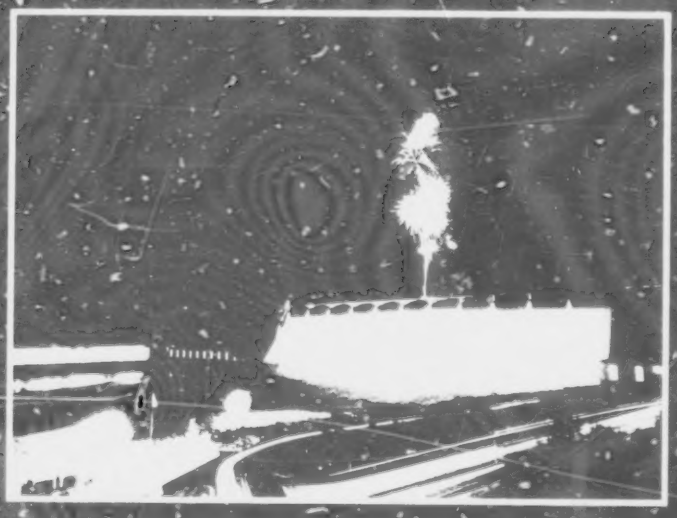

1983 Annual Report

United States Department of the Interior Bureau of Reclamation

ORIGINAL

Commissioner's Letter

To: Secretary of the Interior

I am pleased to submit our 78th Annual Report on Bureau of Reclamation program accomplishments. This report covers our most significant activities during fiscal year 1983 in the planning, development, and operation of water resource projects throughout the 17 Western States and Hawaii. Included are summaries of major program accomplishments in the areas of planning, research, construction, operation and maintenance, foreign activities, and the environmental, cultural, and youth programs.

We have included two special articles in this 1983 issue. "Grand Coulee Dam . . . Celebrating Its 50th" highlights the golden anniversary of Grand Coulee Dam, the key feature of the Columbia Basin Project. The anniversary and the dedication of Grand Coulee's new Third Powerplant were celebrated on July 16, 1983. The second article, "Colorado River Basin Operations — 1983," summarizes events related to the record high water runoffs which occurred in the spring of 1983. Reclamation dams and reservoirs faced major challenges controlling these potentially devastating flows.

Water management, water quality, and water availability are pressing concerns today. The Bureau of Reclamation program continues to address these concerns as it provides leadership in water resource development in the West.

Robert N. Broadbent

Robert N. Broadbent, Commissioner
Bureau of Reclamation

James G. Watt, Secretary
U.S. Department of the Interior

Robert N. Broadbent, Commissioner
Bureau of Reclamation

Robert N. Broadbent

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Preface

This is the 78th Annual Report of Bureau of Reclamation program accomplishments. Its purpose is to provide an overview of the Bureau's role in the Department of the Interior's program for developing and managing our natural resources to meet the present and future requirements of society.

This report summarizes fiscal year 1983 accomplishments in the areas of planning, research, construction, operation and maintenance, foreign activities, and environmental, cultural, and youth programs.

The Annual Report was formerly published as a summary volume with three statistical appendixes. These appendixes now appear as three volumes of a separate report entitled "Summary Statistics."

Summary Statistics Vol. I, *Water, Land, and Related Data*, contains data on crops and multipurpose functions such as municipal and industrial water service, power, recreation, and flood control. Vol. II, *Finances and Physical Features*, contains cost and repayment data, the Bureau's "Consolidated Financial Statement," and related historical data. It also contains physical statistics on the various types of dams, canals, powerplants, and related features constructed or operated under Reclamation's program. Vol. III, *Project Data*, presents, on an individual basis, much of the data summarized in the other volumes.

Dickinson Dam, North Dakota.

Spillway at Grand Coulee Dam.

Sculpture adorns balcony on downstream face of the Third Powerplant.

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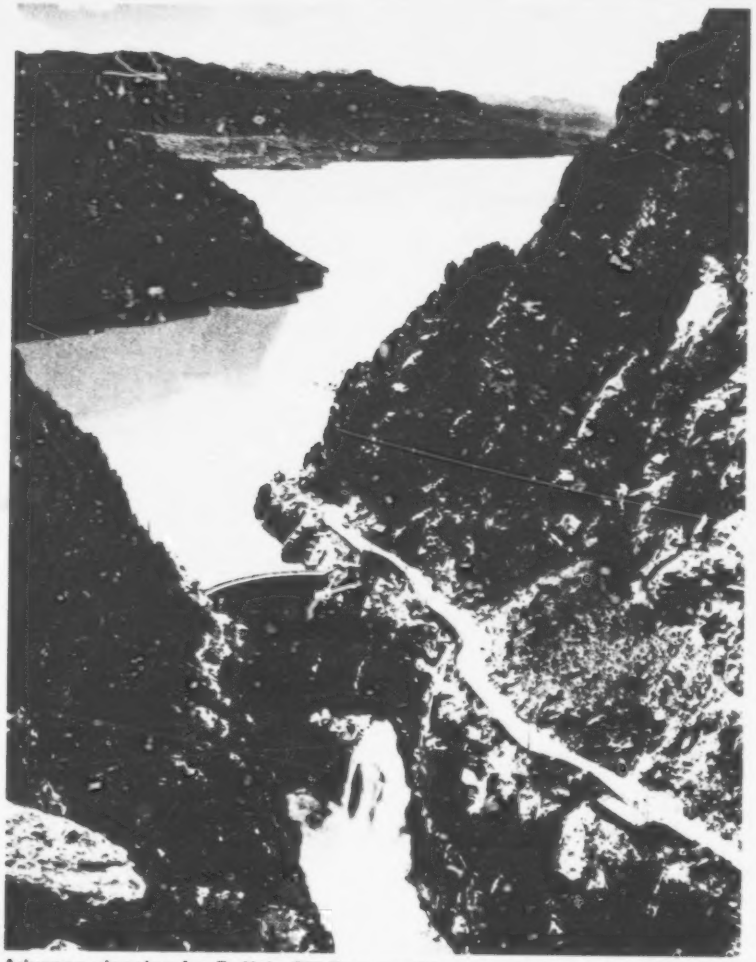
Planning



Advance planning for Buffalo Bill Dam modifications began in FY 1983. This historical structure is a popular tourist attraction in northwestern Wyoming.

The Bureau of Reclamation planning program continues to determine ways of meeting water and energy needs in the 17 Western States and Hawaii. Working closely with State and Federal agencies, other organizations, and the public, Reclamation planners investigate water-related needs and develop and evaluate various alternative plans to meet those needs. Planning activities involve water resource development for increased energy production, municipal and industrial use, irrigation, water quality control, flood control, fish and wildlife, recreation, environmental enhancement, Indian reservation use, and other related purposes.

Planning investigation expenditures totaled $23.4 million in FY (fiscal year) 1983, with 12 new plan formulations and 2 advance planning investigations initiated and work continuing on 47 other studies. Reclamation completed and released 17 planning reports to the Congress and the public. Of that number, 13 reports either identified potential projects or provided information about specific problems or ongoing studies. The remaining reports did not support continuation of the studies.

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Planning activities in 1983 focused on increasing municipal and industrial water supplies, irrigation, domestic energy generation capability, and solving salinity concentration problems.

CENDAK (Central South Dakota Water Studies) was one of several studies with primary emphasis on irrigation development. The purpose of this study is to investigate the potential for transporting and developing water from the Missouri River for use in Central South Dakota. The economic base of the project area consists primarily of dryland farming and ranching. Varying weather conditions greatly influence the level of agricultural production from year to year, which in turn causes widely fluctuating livestock feed production. This affects the incomes of farmers and ranchers and, because business activity is dependent upon agriculture, the business people also suffer during drought years. These widely fluctuating incomes could be somewhat stabilized through the benefits that irrigation provides.

Other multipurpose aspects such as municipal and industrial water, fish and wildlife, and recreation also are being considered as part of CENDAK. The study has been included in the South Dakota State Water Plan by the South Dakota legislature. The plan formulation is a joint responsibility of local interests, the State of South Dakota, and the Bureau of Reclamation, with all sharing the cost. The study is scheduled for completion in FY 1985.

Municipal and industrial water use was evaluated on several projects in 1983, including the ongoing investigation of the Santa Margarita Project, California. Located in northern San Diego County near Fallbrook, the project area is partially on the Camp Pendleton Marine Corps Base. The project would provide flood control for Camp Pendleton, supplemental municipal and industrial water to the Fallbrook Public Utility District and Camp Pendleton, and supplemental irrigation water to the District. Facilities would capture an average of 11,540 acre-feet of new water per year from the Santa Margarita River and would provide valuable seasonal storage for imported water supplies, alleviating peak period delivery problems in the northern San Diego County area. The study is scheduled to be completed in FY 1984.

Another significant new study started in FY 1983 was the Columbus Bend Municipal and Industrial Water Supply Study. The study area is located in the lower Colorado River Basin and adjacent coastal areas below Austin, Texas. This investigation is directed toward optimum use of lower Colorado River water resources. Project purposes are municipal and industrial water supply, flood control, hydroelectric power, fish and wildlife, recreation, and environmental quality enhancement. Previous studies indicated that a dam and reservoir development alternative near Columbus, Texas, is the most promising plan.

The Columbus Bend site has the potential for a hydroelectric powerplant in the range of 25,000 to 50,000 kilowatts. Preliminary consultation with the Fish and Wildlife Service and Texas Department of Water Resources indicates that some storage in a reservoir at that location could be allocated for the timely needs of the downstream estuary to maintain marine life productivity. The Texas Department of Water Resources, other State agencies, and the Lower Colorado River Authority have expressed strong support for the study. Those entities also will contribute part of their staff and a significant amount of data to assist in the conduct of the study. The investigation is scheduled for completion in FY 1985.

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In FY 1983, advance planning work began on two investigations: the Palisades Powerplant Enlargement and the Buffalo Bill Dam Modification. The Palisades Powerplant Enlargement and appurtenant facilities are located on the Snake River in southeast Idaho. The enlargement includes extension of the existing powerhouse and the construction of two 45,000-kilowatt generating units, which, in addition to the existing four units, would bring the installed capacity up to 208,750 kilowatts. Increased annual energy production is projected to be 158 million kilowatt-hours (equivalent to 9,600,000 gallons of oil).

The Buffalo Bill Dam Modification project will replace an obsolete 5.6-megawatt powerplant, increase the available water supply, and solve a dust problem on the upper end of the reservoir. The energy shortage, conservation of nonrenewable resources, and the pollution-free qualities of hydroelectric energy make the new 21-megawatt powerplant in this proposal very attractive. Since the old Shoshone Powerplant was shut down in 1980 due to obsolescence, no electrical energy is being produced by water as it is released from Buffalo Bill Reservoir to the river. Increasing the height and size of the reservoir will increase the amount of energy which can be generated when the powerplant is replaced and also will increase the water supply available for municipal and industrial uses and irrigation.

Colorado River Quality Improvement Program

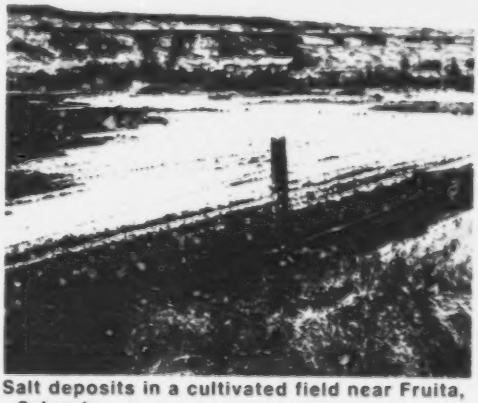
The CRWQIP (Colorado River Water Quality Improvement Program) investigations are developing a comprehensive and cost-effective program for salinity control in the Colorado River Basin. Salinity standards for the Colorado River, including numeric criteria for the lower mainstem, were established in 1975. Additional development of the basin's water resources will cause salinity levels to exceed the numeric criteria unless salinity control measures are implemented. Natural sources contribute the largest share of the salt load; however, return flows from irrigation and municipal and industrial uses also make significant contributions. In addition, the normal salt load is concentrated into smaller volumes of water by out-of-basin exports, evapotranspiration by irrigated crops, and evaporation from large reservoir surfaces.

CRWQIP general investigations program expenditures in FY 1983 were $5.6 million. Plan formulation studies were active on 11 units in the Upper and Lower Colorado Regions, with support activities provided by personnel at the E&R (Engineering and Research) Center in Denver.

Reclamation's feasibility report and draft environmental statement on the Lower Gunnison Basin Unit in Colorado were filed with the Environmental Protection Agency on January 4, 1983. Basic data collection on the balance of the Lower Gunnison Unit is underway.

The recommended plan for the Big Sandy River Unit, Wyoming, would remove saline water by collection wells in spring and seep areas of the Big Sandy River. The State of Wyoming is reviewing the U.S. Department of Agriculture and Reclamation salinity control plans before deciding to proceed with preconstruction planning and authorization.

Reclamation reinitiated salinity studies in the LaVerkin Springs Unit, Utah, to evaluate a new concept for diverting the saline springs to clay-lined evaporation ponds. The Washington County Water Conservancy District in Utah is interested in reducing salinity



Salt deposits in a cultivated field near Fruita, Colorado.

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and providing water from their Quail Creek Project to replace depletions caused by the evaporation of saline water.

Under the Saline Water Use and Disposal Opportunities Unit, Reclamation is working with the Colorado River Basin Salinity Control Forum, the Environmental Protection Agency, utilities, and others to identify proper site and cost-sharing possibilities for installation of a saline water cooling tower at a powerplant located in the Colorado River Basin. Installation of a saline water cooling tower at an existing powerplant appears to be the most cost-effective way to verify the use of saline water for powerplant cooling and to address industries' concerns regarding equipment reliability.

Plan formulation continued on the AQUATRAIN Project, a cooperative effort of Government and private industry. Reclamation has the lead agency role for the proposed pipeline system which would transport saline water, coal, and possibly other commodities from as far north as Wyoming to markets in the Southwest or the Pacific Coast for export.

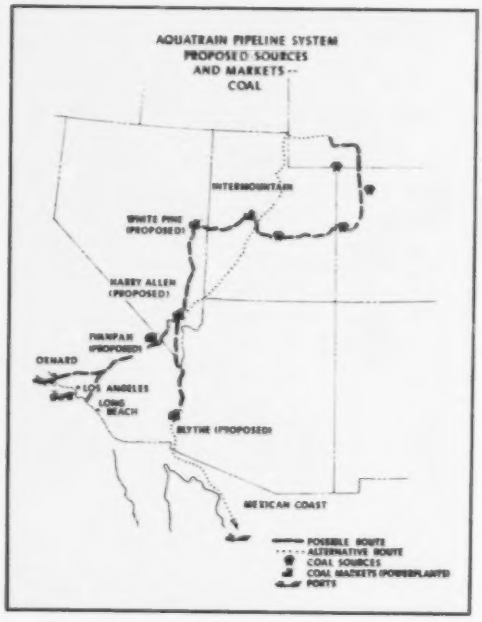
AQUATRAIN's objectives are to reduce Colorado River salinity by diverting saline water and carrying it to points of beneficial use and to economically transport western coal to domestic and export markets. The aim of these combined objectives is to minimize energy costs for new and existing coal-fired electric utility powerplants by providing low cost delivery of superior grade coal and/or coal products and to make saline water available for powerplant cooling.

Technology developments and new opportunities for pipeline use continued to emerge in 1983 as AQUATRAIN planning progressed. Liquid carbon dioxide (CO_2) appears to be the most promising medium to meet the critical project objective of competitive product transport in a pipeline system. Pilot plant tests indicated that a slurry mixture of 85 percent coal and 15 percent liquid CO_2 — an increase over previous ratios — is possible and could be transported long distances.

Preliminary plans for a 14-mile demonstration unit, to be followed by three distinct stages of pipeline system construction, were prepared. The demonstration unit, to be constructed by industry, would include a test loop for the slurry line and a cooling tower using saline water. Construction is projected for 1984-85. Following the demonstration unit, the other stages would be constructed based on investments and market demands.

A significant change in AQUATRAIN management occurred in late FY 1983, as W. R. Grace & Company (the parent company of Aquatrain, Inc.) decided to transfer its lead industry sponsorship role to others having experience in forming venture consortiums and in building interstate pipelines. A formal offer to effect the transfer is expected to be presented to the Bureau of Reclamation for approval in FY 1984.

Planning for AQUATRAIN remains open to the public, with Reclamation seeking continued participation of concerned citizens and groups, other segments of Government, and industry to identify corridors, determine local needs, and define strategies to meet those needs.



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Research

Gathering limnological data at Twin Lakes, Colorado.

The Bureau of Reclamation's research program aims at improving technology to support Reclamation's mission of water and power resource development in the West. Research in FY 1983 involved activities in Program Related Engineering and Scientific Studies and Atmospheric Resources Research.

Program Related Engineering and Scientific Studies

This applied, problem-oriented research program covers a wide range of needs related to the planning, design, construction, and operational phases of water resources development. Research ranges from social, economic, and environmental studies to purely technical studies in the engineering field. This research is divided into several categories for budget purposes and to aid in establishing priorities. These categories are: water supply augmentation and conservation, water quality and ecology, planning, engineering, dam safety, and advanced energy.

PRESS (Program Related Engineering and Scientific Studies) was funded at $5.1 million in FY 1983. At this level, 107 research projects were underway, with 15 of these completed during the year.

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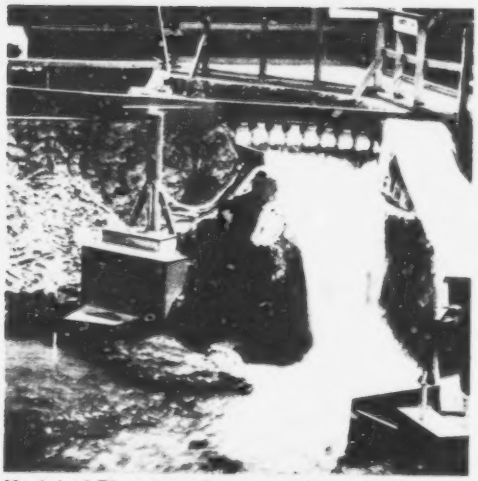


Model of Theodore Roosevelt Dam, Arizona, is located in the Engineering and Research Laboratories in Denver.

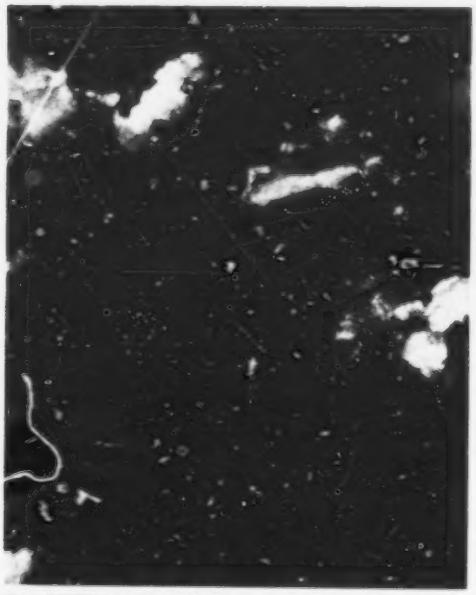
Research projects in the following areas were completed in FY 1983.

- Computerized ground water analysis
- Environmental data collection and management
- Remote sensing limnological applications
- Concrete dam insulation systems
- Polymer concrete applications
- Structural hydrodynamics
- Decision-risk analysis
- Fuse plug spillway design and application
- Labyrinth weir auxiliary spillway design
- Solar total energy applications
- Solar salt gradient pond study

Research produces not only tangible cost savings but also many intangible benefits — such as increased safety and longer life for structures and equipment and research results for use by other Government agencies, private enterprise, and other nations.

Reclamation's research program constantly changes to meet new challenges and needs. New projects are selected for funding by a Bureau-wide prioritizing process. Managers, researchers, and users of research results select the highest priority projects to be included in each year's research program. This program not only solves problems, develops new technology, and provides lower cost materials; it also is very cost-effective. In a typical year, the benefit-cost ratio is on the order of 10 to 1, not including intangible benefits.

Atmospheric Resources Research



The SCPP studies winter cumulus clouds, such as these, which provide snow showers on the upslope of the Sierra Nevada.

One of the Nation's leading atmospheric research and weather modification programs, Project Skywater focuses on developing effective cloud seeding technology for water supply augmentation that is compatible with environmental, social, and economic concerns. Project Skywater employs a "learning while doing" concept. Research varies from theoretical modeling to field seeding experiments and equipment development. The program is carried out in cooperation with State agencies and university researchers. Reclamation also participates in international development projects on weather modification. In 1983, efforts included cooperation with the Panama Canal Commission to mitigate effects of a drought and cooperative research in the Canary Islands. Exchange of research information with other countries is important facet of the program.

Sierra Cooperative Pilot Project

The Reclamation-sponsored SCPP (Sierra Cooperative Pilot Project) is the only major weather modification research program that is federally funded. Its primary mission is to identify conditions which lead to precipitation increases through the application of prudent cloud seeding techniques. The study area for SCPP activities encompasses the higher elevations of the American River Basin and portions of the Truckee-Tahoe Basin in California and Nevada.

The objective of SCPP in FY 1983 was to carry out the first year of a formally randomized exploratory seeding experiment on orographically induced convective clouds. Excessive winter precipitation limited the formal seeding experiment to 1 experimental day. However, the numerous storms provided a perfect laboratory for studying the seeding potential in other portions of Sierra storms.

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Approximately $2.4 million was used to support the work of the Bureau's SCPP staff and nine contractors in 1983. The contractors employed approximately 45 scientists from private industry and universities in carrying out the 1982-83 field operations and data analyses. Instrumentation used in field research included a digital weather radar, a radiometer, a cloud physics aircraft, a mobile ground microphysical laboratory, and a high-altitude wind and icing measurement station. Information from these sources provided the knowledge necessary to identify previously unexplored seeding opportunities in the Sierras.

In FY 1983, plans were prepared for coordinating SCPP activities more closely with ongoing private weather modification programs in California and Nevada and with other water resource agencies. In this way, the technology developed in SCPP can be transferred to help meet the critical needs of water users. Preliminary benefits are being realized during the planning for the 1983-84 field season, when SCPP monitoring devices will be used to help evaluate a long-standing commercial seeding operation.

Colorado River Enhanced Snowpack Test

During 1983, draft legislation for CREST (Colorado River Enhanced Snowpack Test) was submitted to the Office of Management and Budget. A program plan and FONSI (Finding of No Significant Impact) for the CREST program were also completed. CREST planning activities concentrated on identifying the equipment and activities required for the demonstration program and for computer simulation of anticipated program results. The present plan provides for an 8-year demonstration program in two subbasins to confirm and assess the potential for augmenting Colorado River flows by means of safe and reliable cloud seeding technology. Following the 8-year test period, a decision could be made to include the entire river basin in the cloud seeding operations.

According to the Bureau's Colorado River Simulation System Model, the estimated potential augmentation of streamflow in the Upper Basin would be 1.43 million acre-feet annually in an operational program. The Lower Basin could receive an additional

Aircraft measures and records atmospheric variables and dispenses cloud seeding agents.

Electronic wind direction and wind speed sensor.

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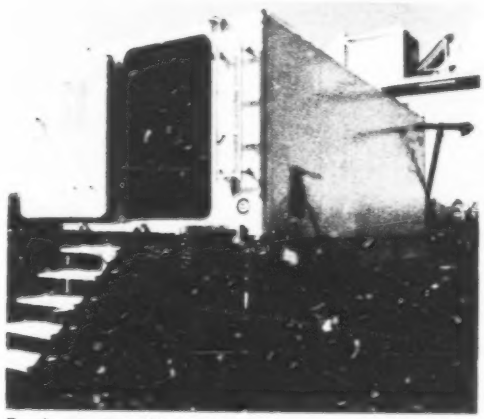
300,000 acre-feet from operations in the Mogollon Rim. Another 533,000 acre-feet of new runoff could occur in the adjoining Rio Grande, Missouri, Snake, and Arkansas Basins. The additional water would be used to increase hydroelectric power ($34.4 million benefit annually); to reduce salinity in the basins' streams and rivers ($56.5 million annually); to meet national obligations under the 1944 Mexican Water Treaty; and to increase the municipal, industrial, and agricultural water supply for the Colorado and adjacent river basins ($48.5 million annually). CREST planning and development efforts could result in a basinwide operational program that could provide benefits estimated at approximately $139.4 million per year, or 9 to 12 times its annual cost.

Scientists monitor soil moisture and vegetation growth in natural grasslands to discover the long-term environmental effects of additional rainfall produced by cloud seeding.



Dual-wavelength passive microwave radiometer remotely measures water vapor and liquid water content in clouds.

Colorado River Augmentation Demonstration Program

Colorado River Augmentation Demonstration Program activities in FY 1983 consisted of limited field operations in the Grand Mesa, Colorado area. During January-February, factfinding and data collection studies were conducted in cooperation with the University of North Dakota and the National Oceanic and Atmospheric Administration using a variety of atmospheric research equipment including a radiometer, satellite imagery, and cloud physics aircraft. A field office was established in Montrose, Colorado, in August 1983, and installation of equipment in the Grand Mesa area continued through the close of FY 1983.

Southwest Drought Research Program

Upon completion of a final report in FY 1983, the Southwest Drought Research Program was concluded. The program was initiated in FY 1979 after the Senate Committee on Appropriations recommended that the Bureau allocate $1 million to conduct rain augmentation research in southwestern areas where drought patterns were developing.

One of the most significant conclusions of the study was that weather modification can make its greatest contribution to drought mitigation if applied in a long-term program, during both drought and nondrought years, to help maintain soil moisture and reservoir storage at near normal levels.

The program studied both technical and institutional issues, but no actual cloud seeding was conducted. The work was accomplished primarily through cooperative agreements with State agencies in Arizona, Colorado, Oklahoma, Texas, and Utah. It demonstrated that both Federal and State interests in weather modification can be advanced through cooperative efforts, and it laid significant foundations for any future weather modification research or operational programs in the region.

High Plains Cooperative Program

The HIPLEX (High Plains Cooperative Program) study was concluded in FY 1983 with the completion of the HIPLEX final report. HIPLEX involved field projects at Big Spring, Texas; Goodland, Kansas; and Miles City, Montana; as well as supporting studies in short-range forecasting, cloud modeling, forage and crop yields, agricultural economics, and environmental matters.

HIPLEX points the way to improved short-range forecasts of convective clouds and storms and, therefore, to more carefully

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controlled future experiments on larger convective clouds. The final report will be available in early 1984.

Windpower

Preliminary windpower surveys are part of Reclamation's effort to develop alternate energy sources. In FY 1983, 23 atmospheric research PROBE (Portable Remote Observations of the Environment) stations were installed in remote areas to collect and transmit data on potential windpower generation sites to a receiver located at the E&R Center for computer analysis. This analysis will determine the wind energy potential and reliability at the sites.

Canary Island Rain Stimulation

This technical assistance program for rain stimulation on Grand Canary completed the second of six planned winter seasons in April 1983 and was then suspended. Delays in replacing the expiring U.S./Spain Treaty of Friendship and Collaboration with a new agreement caused an interruption in the funding. The local Government of Grand Canary has authorized its support for an abbreviated program during the 1983-84 rainy season, in the hope that international funding may be arranged in time to resume the full research activity.

Panama Canal

In late April 1983, the Panama Canal Commission asked the Bureau of Reclamation for help with a program of cloud seeding for drought relief. The winter dry season had begun a month early, in October, and had been severe. Gatun Lake had fallen so low that maximum draft of ships using the canal had to be reduced to about 3 feet less than normal. Operating income was severely affected. Madden Lake, a reservoir serving the canal and also forming the water supply for Panama City, was down to within 2 feet of the aqueduct intake. Lake Bayano, the hydroelectric reservoir source for Panama City's electricity, was so low that rotating brownouts were begun.

With the help of a Bureau scientist, approval of a joint program between the Panama Canal Commission and the Instituto de Recursos Hidaulicos y Electricidad, a Panamanian Government agency, was expedited. At a cost of $325,000, the Bureau contracted with a commercial cloud-seeding company to send two specially equipped airplanes to Panama. Cloud seeding began on Memorial Day and continued for 90 days, whenever suitable weather occurred. Early in September, the timely return of heavy natural rains brought the crisis to an end.

Because of the emergency character of the operation, there was little opportunity for scientific evaluation of the results. Nevertheless, analysis of the weather and rainfall which occurred during the operation is proceeding.

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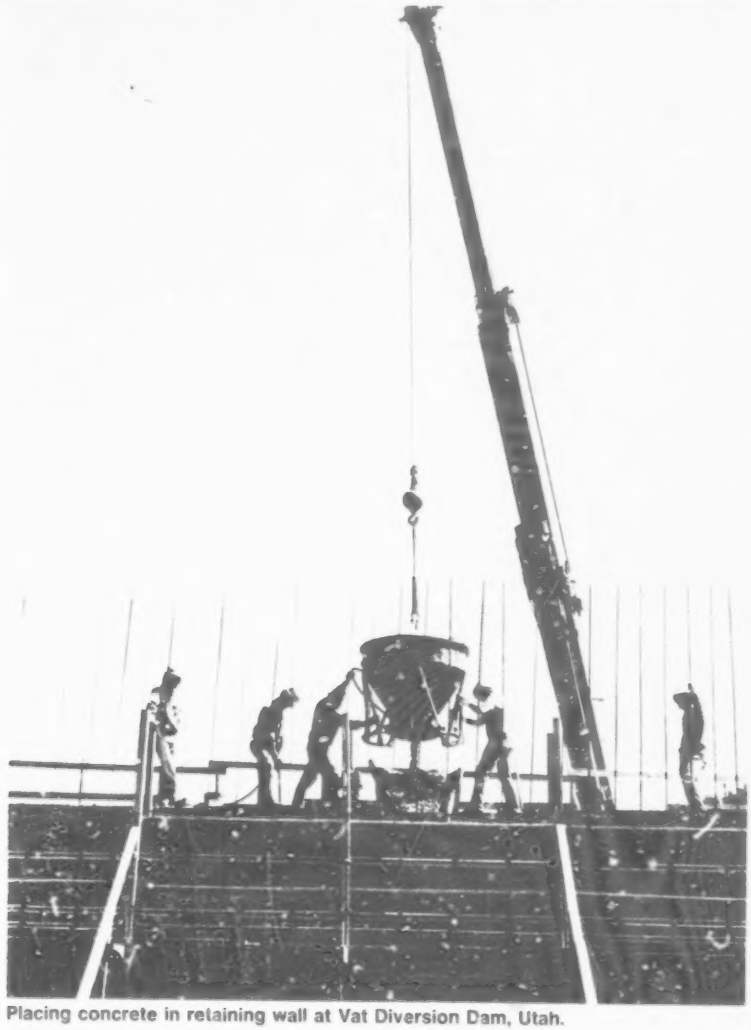
Construction



Placing concrete in retaining wall at Vat Diversion Dam, Utah.

The Bureau of Reclamation construction program continued in all seven regions, with the completion of many existing contracts and issuance of new contracts totaling approximately $318 million in FY 1983.

Pacific Northwest Region

Major construction work in the Pacific Northwest Region continued on the Columbia Basin and Chief Joseph Dam Projects. Minor construction also continued on the Minidoka, Boise, and Yakima Projects.

A $35-million contract was awarded and construction began on the Columbia Basin Project stabilization program. This program provides for resloping and riprapping 6-1/2 miles of the Columbia River downstream of Grand Coulee Dam.

Major construction at Grand Coulee Dam and Powerplant consisted of repairing the fire-damaged extra high voltage cable tunnel

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to the 400-kV (kilovolt) cable spreading yard, completing drainage wells, constructing a mechanical repair and service building, and completing industrial area electrical modifications.

Also on the Columbia Basin Project, development of Block 26 laterals, located about 35 miles west of Othello, Washington, was essentially completed. Approximately 29 miles of concrete-lined laterals and 7 miles of 12- to 72-inch-diameter pipelines were constructed, which will deliver water to irrigate about 13,000 acres.

On the Chief Joseph Dam Project, the $11-million Cordell and Crater Lakes distribution system was completed. Construction of the Ellisford, East Tonasket, and Bonaparte Creek distribution system was begun and is estimated to be approximately 90 percent complete by yearend.

Three other contracts were awarded and completed in Idaho: minimum health and safety facilities at Little Wood Reservoir, road resurfacing near Ririe Dam, and dike construction at Island Park Dam. The Island Park contract is the first of two contracts for raising the dam and dike and replacing a portion of the right abutment for dam safety purposes.

Work began on the $62-million Yakima-Tieton rehabilitation and betterment program, with five major contracts underway. This program consists of replacing 320 miles of open canals and low-head pipe with 210 miles of 4- to 40-inch-diameter pressure pipelines, complete with three booster pump stations, two hydroelectric generating plants, and a regulating reservoir at the head of the system.

A contract was awarded for the installation of buried membrane lining along portions of the Kennewick Main Canal. Construction was performed at the request of the Kennewick Irrigation District, which secured an emergency loan to finance the project.

Mid-Pacific Region

The Mid-Pacific Region awarded $86.2 million in new construction contracts during FY 1983. Work was performed primarily on the Central Valley and Solano Projects in California, the Klamath Project in Oregon, and the Washoe Project in Nevada.

New awards on the San Felipe Division, Central Valley Project, included: a $14.5-million contract for construction of Pacheco Pumping Plant and Substation; a $12-million contract for the Pacheco Conduit, Section I; and a $17.4-million contract for the construction of Santa Clara Conduit, Section I.

Other Central Valley new construction consisted of 24 contracts totaling $9 million, including 5 negotiated 8(a) contracts for approximately $1.3 million. Four awards, totaling $2.6 million, were funded by the Jobs Bill.

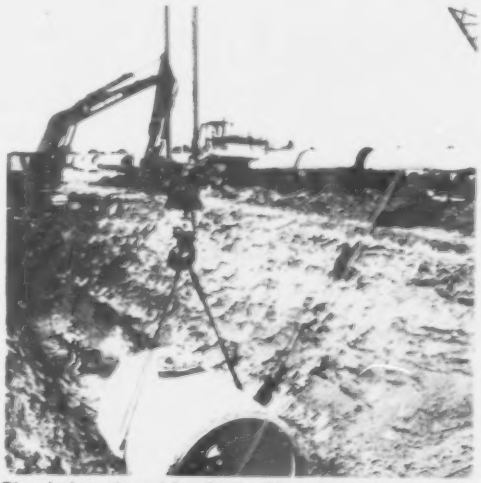
Two contracts totaling $2.2 million were awarded on the Solano Project, California. The main contract award, using Jobs Bill funds, was for the $2.1-million administrative complex at Lake Berryessa.

Four new contracts were awarded on the Washoe Project. The major award was a $3.2-million contract for Stampede Powerplant and Switchyard, California.

Four contracts, totaling $2.4 million, were awarded on the Klamath Project. Included was a $2.1-million Jobs Bill contract for completion of Klamath Straits East.

Lower Colorado Region

The Central Arizona Project, the Robert B. Griffith Water Project, and the CRBSCP (Colorado River Basin Salinity Control Project)



Pipe being placed for Santa Clara Conduit, Central Valley Project, California.

Special backhoe bucket is used to excavate pipe trench for Santa Clara Conduit.

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Title I are the three major ongoing construction projects in the Lower Colorado Region. These projects provide water for agricultural and municipal and industrial use. The CRBSCP protects the quality of Colorado River water available for delivery to the Republic of Mexico.

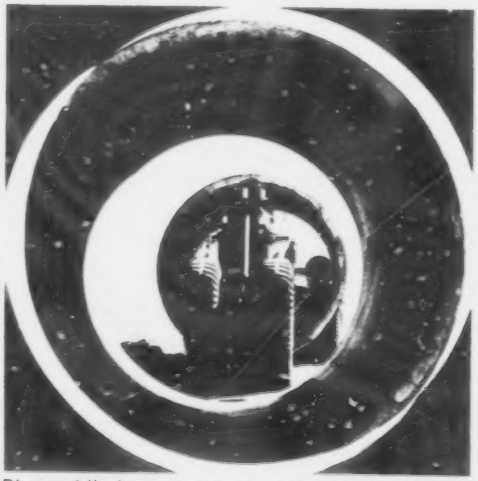
The Central Arizona Project is a 300-mile-long aqueduct system of interconnected pumping plants, tunnels, concrete-lined canals, and siphons designed to convey an annual average of 1.2 million acre-feet of allocated Colorado River water to the Phoenix-Tucson area. This multipurpose project will provide supplemental agricultural and municipal and industrial water to help reduce the present groundwater overdraft condition existing in Maricopa, Pinal, and Pima Counties.

During 1983, work continued on the 190-mile-long Granite Reef Aqueduct, with a contract awarded for completion of Reaches 1-5. Work also continued on the power system required for operation of Granite Reef Aqueduct. On the Salt-Gila Aqueduct, contracts were awarded for Reaches 1B and 4. The contract award for Reach 1B was a significant achievement in that the entire length of the canal, from the beginning of the Granite Reef Aqueduct to the end of the Salt-Gila Aqueduct, is now either completed or under construction. Features transferred to Western Area Power Administration in FY 1983 were the Harcuvar Substation, Hassayampa Tap Substation, and Harcuvar-Bouse Hills and Harcuvar-Little Harquahala 115-kV Transmission Lines.

The Robert B. Griffith Water Project was declared substantially complete on February 28, 1983. The first and second stages of this project are capable of delivering 299,000 acre-feet of water annually to the residents of Southern Nevada.

Under the CRBSCP, Title I, construction continued on the Yuma Desalting Plant. The 161-kV transmission line from Knob Substation to the Yuma Desalting Plant was transferred from Bureau of Reclamation to Western Area Power Administration.

Granite Reef Aqueduct, Central Arizona Project. Flood detention dikes are visible to the left of the aqueduct.



Pipemobile leaves storage area with pipe for a siphon on the Central Arizona Project.

Upper Colorado Region

In the Upper Colorado Region construction continued on the Central Utah, Dolores, Dallas Creek, and Colorado River Basin Salinity Control Projects, along with repairing the damage caused by the 1983 high water runoff.

Construction progressed on several features of the Bonneville Unit, Central Utah Project, including Stillwater Tunnel, which was holed through on September 14, 1983. Contracts completed or essentially completed during FY 1983 included the Vat Tunnel, Hades and Rhodes Tunnels, and Upper Stillwater Dam foundation excavation. Numerous smaller contracts were awarded on the Bonneville Unit for recreation facilities, drilling, buildings, and road repairs.

Significant progress was made on McPhee Dam, Dolores Project, with construction approximately 95 percent complete at yearend. Work on Dolores Canal and Tunnel also continued, with the tunnel drilled and lined during the year. The Dolores Project also had numerous small construction projects underway during the year including building additions, recreation facilities, and roads.

On the Dallas Creek Project, work on Ridgway Dam, Stage 2, progressed. Grouting was underway, structures were completed, and the placement of fill began.

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Under the CRBSCP, the moss and debris removal structure at Grand Valley, Colorado, and the Government Highline Laterals, Stage 1, were both completed.

One of the major problems facing the Upper Colorado Region in 1983 was the damage done by record high water runoffs. A special article entitled "Colorado River Basin Operations — 1983," which summarizes the events related to these devastating flows, is included in this report.

Southwest Region

Ongoing construction in the Southwest Region included work on the Brantley, San Luis Valley, McGee Creek, and Navajo Indian Irrigation Projects. Follow-on work for recreation facilities was also underway at the Nueces River Project, Texas.

Relocation of U.S. Highway No. 285 was initiated at Brantley Project, New Mexico, and a contract was awarded for construction of the field office and laboratory building.

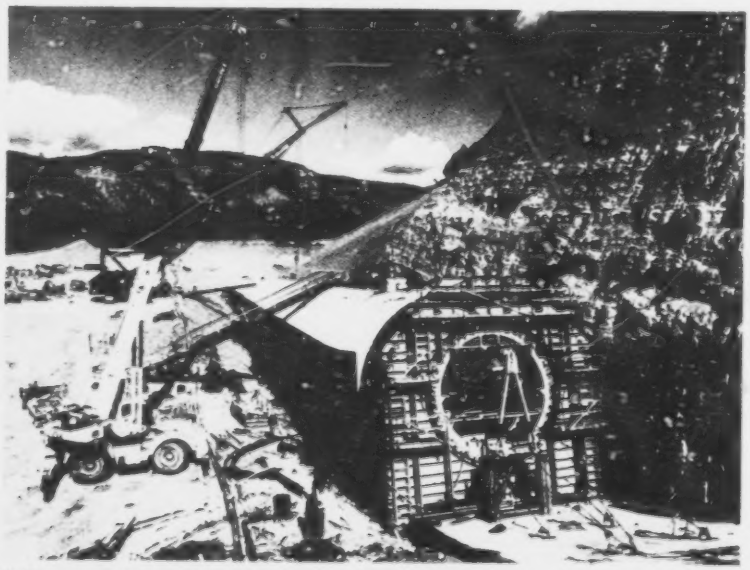
Significant progress was made on salvage wells for the Closed Basin Division, San Luis Valley Project, Colorado. Contracts for the first reaches of pipeline laterals and the main conveyance channel were awarded and work began in 1983.

Construction of McGee Creek Dam, Oklahoma, was fully underway. A contract was awarded for the pumping plant and aqueduct for this multipurpose municipal and industrial water supply project.

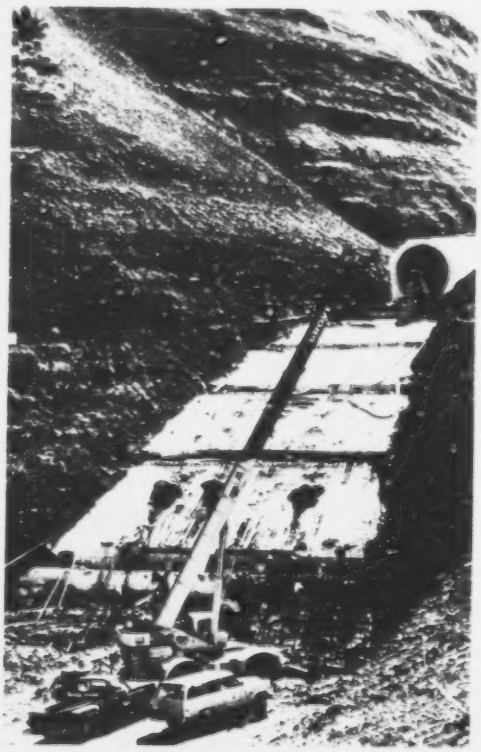
Slope stabilization for the main canal headworks at Navajo Indian Irrigation Project, New Mexico, and canal repairs were completed. A contract was awarded for pipe laterals and pumping plants in Block 6 for Stage 1A.

Upper Missouri Region

Court-ordered construction restraints were lifted on the Garrison Diversion Unit in North Dakota, and four major contracts, totaling over $24 million, were awarded. These included Oakes Pumping



Spillway conduit under construction at Ridgway Dam, Colorado.



Setting forms for placement of concrete in spillway chute, Ridgway Dam, Dallas Creek Project.

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Installation of plastic drain pipe, Riverton Unit, Wyoming.

Plant; Oakes Drains; New Rockford Canal, Reach 1B; and Lonetree Dam.

A contract was awarded for the Yellowtail Dam Powerplant Electrical Bypass. Rehabilitation of the Riverton Unit, Wyoming, continued with work on canals, laterals, and drain installation.

Lower Missouri Region

New construction contracts totaling $13.3 million were awarded during 1983 in the Lower Missouri Region. Progress continued toward completing the Fryingpan-Arkansas Project in Colorado, with contracts awarded for electrical installation and testing of Unit 2 at the Mt. Elbert Pumped-Storage Powerplant and for modifications at Twin Lakes Dam.

In Nebraska, work progressed on the North Loup Division, Pick-Sloan Missouri Basin Program, with contracts awarded for the final stage of construction on Calamus Dam and for the Mirdan pipe laterals system.

Other major contracts initiated in 1983 provide for an addition to the Casper Control Center and Stage 2 additions to the Glendo Switchyard, Pick-Sloan Missouri Basin Program; rehabilitation of the north spillway chute at Guernsey Dam, North Platte Project; and microwave equipment for the radio communications system serving the features operated by the North Platte Projects Office, Wyoming.

Geology

Reclamation geologists conduct engineering and geologic studies for water resource projects in the 17 Western States and Hawaii and also in several foreign countries. These studies are conducted during all stages of project development and include a wide range of geologic activities.

In FY 1983, new computer hardware and software were acquired to provide new services for Reclamation offices. This equipment helps geologists and engineers analyze geotechnical data, produces computer-generated drawings, and provides faster, more efficient data storage, retrieval, and evaluation. Data can now be stored digitally, retrieved and analyzed at the E&R Center, and the results or drawings transmitted to the field; or the data can be transferred to comparably equipped field offices for analysis. These advances provide more timely and detailed evaluation and modification of geologic data and, therefore, more efficient assessment of geologic considerations for design and construction.

A companion data processing system employed by Reclamation geophysicists provides rapid processing of various types of geophysical data including crosshole shear wave measurement, surface electrical resistivity, self-potential, seismic refraction, and borehole geophysical well logs. In 1983, over 30 different geophysical surveys were performed on existing structures or proposed sites.

A billboard for geologic computer programs also was established in 1983. Other users can access and/or add to the billboard to share new geologic computer programs or to reduce ADP (automated data processing) storage costs for field offices.

Safety of Dams

Reclamation's SOD (Safety of Dams) program is the mechanism for correcting dam safety problems identified through the EES (Examination of Existing Structures) program. Authorization for structural modifications to Bureau dams was provided under the

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Reclamation Safety of Dams Act of 1978. The act authorized appropriations not to exceed $100 million for the costs of structural modifications due to new hydrologic or seismic data or changes in the state-of-the-art criteria deemed necessary for dam safety. The act requires that a modification report be submitted to Congress for review before construction can begin.

SOD activities continued in FY 1983 at a cost of about $10.6 million. Modifications to raise the crest at Lake Sherburne Dam, Milk River Project, Montana, were essentially completed. Construction continued at Deerfield Dam, Rapid Valley Project, South Dakota, to raise the dam crest and modify the spillway and outlet works. Construction contracts were awarded to replace deteriorated spillway concrete at Guernsey Dam, North Platte River Project, Wyoming; to rehabilitate the spillways and outlet works at Lahontan Dam, Newlands Project, Nevada; and to raise the crest and construct berms at Island Park Dam, Minidoka Project, Idaho. Also, the modification report for Island Park Dam, Stage II, which includes the work already awarded in FY 1983 plus future work to replace liquefiable material in the dam, was approved by Congress.

Nearly completed Safety of Dams work to raise the crest at Lake Sherburne Dam, Montana.

Department of the Interior Dam Safety Program

Reclamation is responsible for assisting other Interior agencies in developing adequate dam safety programs. Program costs in FY 1983 totaled about $400,000 with the following significant program accomplishments:

- Issued "Operation and Maintenance Guidelines for Small Dams" to provide minimum standards for small dams up to a maximum of about 75 feet in height
- Issued "Dam Safety Hazard Classification Guidelines" for preliminary classification of existing dams
- Initiated a research project to determine the effects of waterflows over low embankment dams
- Issued a contract for inventory, field verification, and hazard classification of dams on Bureau of Land Management administered lands
- Continued development of dams inventory data bases for the Fish and Wildlife Service, Bureau of Land Management, and Bureau of Indian Affairs

Deteriorated spillway concrete is replaced at Lahonton Dam, Nevada.

Loan Programs

The Reclamation loan programs provide Federal assistance to organizations wishing to construct or improve water resource developments. These programs were made possible by the Small Reclamation Projects Act (Public Law 84-984) and the Distribution System Loans Act (Public Law 84-130). Public Law 84-984 encourages State and local participation in developing water and land resource projects in the West, and Public Law 84-130 enables non-Federal construction of distribution systems on Federal projects. Reclamation's role is to assure the Secretary of the Interior that these projects are financially and engineeringly feasible. As part of

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this process, Reclamation provides technical assistance to loan applicants and their consulting engineers in planning, constructing, and operating their projects.

During FY 1983, notices of intent to apply for loans were received from 10 districts. Thirty applications for loans were in the preparation stage or under consideration within the Department of the Interior.

The Secretary approved 10 new projects under the Small Reclamation Projects Act and the Distribution System Loans Act in FY 1983, representing about $134.4 million in loan funds. These new projects include Columbia Irrigation District, Washington; Douglas County, Oregon; Roosevelt Irrigation District No. 2, Arizona; and Colusa County Water District, Fallbrook Public Utility District, Glide Water District, Oakdale Irrigation District, Rainbow Municipal Water District (escalation loan), Ramona Municipal Water District, and Yuba County Water Agency, all in California.

Construction began on Buffalo Rapids Irrigation District No. 2, Montana; Fallbrook Public Utility District, California; Ramona Municipal Water District, California; and Roosevelt Irrigation District No. 2, Arizona, with $43.3 million in loan funds. Construction continued on 19 other projects in Arizona, California, Colorado, Nebraska, Texas, and Wyoming, representing approximately $148.3 million in ongoing construction costs.

Cooney Dam Rehabilitation, Montana, and Hidalgo County Water Improvement District No. 5, Texas, compieted their construction programs with approximately $6.3 million in loan funds.

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Operation and Maintenance

Control room at Keswick Powerplant, Central Valley Project, California.

The O&M (Operation and Maintenance) program is conducted primarily to operate and maintain, on a permanent basis, only power projects and reserve waterworks on multipurpose Bureau of Reclamation projects. The program also involves carrying out associated land and water resource management activities which are designed to assure that such facilities will serve their intended purposes safely and efficiently. All facilities must be operated and maintained in a manner that protects the Federal investment.

Completed water service facilities, except for reserve works, are normally transferred to local water user organizations for operation and maintenance as soon as an organization is able to assume such responsibilities. In FY 1983, 32 ongoing projects and several resource management programs were operated and maintained either entirely by the Bureau or in conjunction with water user organizations.

Water Operations

Review of Operation and Maintenance

Under the Bureau-wide Review of Operation and Maintenance program, technical specialists examined 105 major structures and 92 carriage and distribution systems in FY 1983. These examinations were performed to determine and document the general condition and level of maintenance being performed on storage dams,

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diversion dams, tunnels, canals, pumping plants, powerplants, pipelines, and other structures designed and constructed by Reclamation. Most of these facilities are operated and maintained by water user organizations under contract with the Bureau. Since title to these facilities remains with the Government, scheduled examinations under this program are necessary to enable the Bureau to fulfill its obligation of protecting the Federal investment. Deficiencies in operation and/or maintenance are documented and pursued until corrective measures are implemented.

Water Systems Automation

The Water Systems Automation program is responsible for developing analytical techniques, automatic and remote control equipment, improved structure designs, and criteria for operation of water resource systems. The final product is the application of program results to projects in planning, design, and operating stages of development. Computer programs have been written to simulate unsteady flow in canals and to control hydraulic transients through proper regulation of control structures. These programs are used to determine appropriate control methods on several canals. Gate controllers featuring microprocessor units have been assembled to demonstrate state-of-the-art control technology to canal operators at several locations and a report was completed in FY 1983 on the use of radial gates for flow measurement. This method of flow measurement may eliminate the need for expensive flow measurement devices at many locations.

Rehabilitation and Betterment

The R&B (Rehabilitation and Betterment) program, as authorized by the Rehabilitation and Betterment Act of 1949 and by special legislation, is administered by the Secretary of the Interior through the Bureau of Reclamation to facilitate the R&B of irrigation systems on projects governed by Federal Reclamation law and projects constructed under the Small Reclamation Projects Act. Federal funds are loaned to water user organizations for the repair, replacement, or improvement of irrigation structures and systems which have become obsolete or deteriorated to the extent that improvement costs are more than can be funded by the water user organization.

Benefits that can be derived from an R&B program include better use of the project water supply, improved distribution of water through modern control structures and measuring devices, reduction in frequent and expensive maintenance, improved safety for operating personnel and the public, and environmental enhancement.

Since inception of the program, 105 R&B programs have been approved. Three of these were approved in 1983 and 10 additional R&B program reports are under consideration.

Under the Riverton Rehabilitation and Betterment program, 20 mil plastic lining is installed in Pilot Canal, Wyoming.

Water Management and Conservation

The WMC (Water Management and Conservation) program was developed as a nonstructural means to promote improvements in project and onfarm water systems and management practices. Authority to conduct the WMC program is found in the general provisions of the Reclamation law which authorized the Secretary of the

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Interior to plan, construct, and operate works for the storage, diversion, and development of water in the 17 Western States and Hawaii. The WMC program is concerned with the privately owned lands served by the Reclamation projects.

In addition to reducing water use and losses, program objectives include energy conservation and the protection and enhancement of water quality. Considerable emphasis is placed on water measurement and accounting, evaluation of irrigation efficiencies, and evaluation of the program itself. Intensive use of recent state-of-the-art development in minicomputers and associated software is made in implementing these objectives.

The program covers three general types of activities:

- Developing or adapting new technologies for efficient use of water and energy, and protection of water quality in irrigation operations
- Promoting the use of improved technology and management practices by water users
- Providing technical services and assistance to water user organizations and to allied Reclamation programs

The Bureau has a staff of trained technicians and management support personnel available in all seven regions and in a number of project offices to assist districts in developing water management programs. During the 1983 irrigation season, 30 districts were cooperating, jointly developing, or operating irrigation scheduling and WMC programs with assistance from the Bureau.

A prime objective of these cooperative programs is the establishment of "system scheduling" techniques which incorporate onfarm water management (irrigation scheduling) with the operation of the distribution system. The Bureau has increased system scheduling activities within a number of these districts and plans to demonstrate to others that scheduling onfarm demands with distribution system operation is an integral part of the WMC Program. More than 75,000 acres are involved in the regions using system scheduling programs. An irrigation guide service, which provides the daily evapotranspiration rate for the major crops grown in an area, is being employed on more than 1.8 million acres, with over 80,000 acres receiving a detailed field-by-field irrigation schedule.

Pest and Hazardous Materials Management

Pest and hazardous materials activities under the O&M program directly serve and benefit Reclamation projects by providing effective, economical, and environmentally acceptable pest and hazardous materials management programs. These activities include developing new technology for pest management and providing practical, on-the-job assistance to Reclamation offices and cooperating water users. The pest and hazardous materials management program includes the management of aquatic weeds, aquatic invertebrates, terrestrial weeds, insects, rodents and other vertebrates, and pathogens.

The cooperative research group at the E&R Center assists in the development of improved management techniques through practical research and development activities. In FY 1983 these activities included:

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- Hydrilla and eurasian watermilfoil studies
- Continued effort to amend 2,4-D registration for use on eurasian watermilfoil
- Completion of the copper base antifouling coating registration effort for 2,4-D use on water conveyance structures
- Herbivorous fish studies
- Environmental monitoring studies
- Screening and evaluation of several aquatic and terrestrial herbicides

Proposed uses of pesticides are evaluated annually by assigned O&M personnel for effectiveness, economy and efficiency, legality, and environmental acceptability. Certain more critical pesticide proposals are evaluated by Interior's Pesticide Review Work Group.

The *Herbicide Manual*, a practical, illustrated reference and training aid, is being published for distribution to water user organizations and other public and private groups across the United States, as well as several foreign countries.

During FY 1983, a Bureau pest management scientist traveled to Surinam, South America, to serve as a pest management consultant on local irrigation systems. This assistance was provided under an agreement between Reclamation and the Food and Agriculture Organization.

Coordination and followup activities were also conducted on the monitoring and control of polychlorinated biphenyls in electrical equipment, in accordance with regulations of the Federal Toxic Substances Control Act.

Project Operations and Maintenance Management System

The objective of POMMS (Project Operations and Maintenance Management System) is to establish a uniform, computerized management accounting and reporting system for Reclamation's O&M functions. POMMS is an effective maintenance tool which allows management and O&M personnel to control, report, and analyze work activities, costs, and operational variations for improvement of operation and maintenance in major categories of power and water activities.

In 1979, the installation of POMMS began in single- and multipurpose power projects. The program is now being extended to include single-purpose irrigation projects. POMMS is collecting financial information and generating reports on activities, equipment, systems, and property.

When fully implemented, the POMMS program will compile detailed financial histories, including labor hours, costs by craft, and material and support costs. The detailed financial histories can be used for forecasting budgets, justifying equipment replacement, establishing benchmarks to evaluate new or revised operation and maintenance procedures, and for detecting variations in expenses on a timely basis.

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Examination of Existing Structures

EES (Examination of Existing Structures) program costs totaled about $6.6 million in FY 1983. EES consists of several programs: SEED (Safety Evaluation of Existing Dams), a program to provide periodic examination and evaluation of the safety of Reclamation dams; Earthquake Instrumentation, a program for installing instrumentation to evaluate dams under seismic loading; and Operation of Structures, a program for inundation map preparation, landslide surveillance, and reservoir operating procedures review.

The SEED program involves the examination and analysis of dams to determine if dam safety deficiencies exist. Dams receive an onsite state-of-the-art review every 6 years and a reexamination every 3 years. Based on recommendations resulting from the examination process, the dams are analyzed for hydrologic, hydraulic, seismic, geologic, geotechnical, and/or other considerations. A SEED report is then published presenting the examination findings and recommendations, a technical analysis and evaluation of each recommendation, and an overall dam safety classification. If necessary, field investigations are conducted and minimum instrumentation is installed to further determine if a dam safety deficiency exists.

In FY 1983, reexaminations of 71 Reclamation dams were performed, and final SEED reports were issued for 31 dams. About $3.1 million was spent on the various studies involved in preparing these final reports. In addition, the SEED program provided funding for minimum instrumentation and for fieldwork and additional analyses required to resolve dam safety issues outstanding from the SEED reports on 33 dams, at a cost of about $3.0 million.

The first "Seminar on Safety Evaluation of Existing Dams for Foreign Engineers" was held in 1983. The week-long seminar covered subjects such as emergency preparedness; inundation mapping; geologic, seismic, and hydrologic considerations; sedimentation; evaluation of design, construction, and existing conditions at dams; instrumentation; and case histories of dam failure and near failures. The course attendees also participated in onsite SEED examinations of Hoover and Davis Dams.

Reclamation's Earthquake Instrumentation program involves designing, installing, and maintaining strong motion instrumentation systems in and adjacent to dams for the purpose of evaluating dam performance under seismic loading. The program is scoped to provide information on existing dams as well as data necessary for future analysis and design. In FY 1983, program costs totaled about $106,000 for maintenance of existing instrumentation, installation of three new instrumentation systems, and upgrading or modifying four systems.

The Operation of Structures program involves the review of operating instructions, preparation of an annual landslide register, and preparation of inundation maps. Expenditures during FY 1983 totaled $384,000, of which $263,000 were used to prepare inundation maps for water user-operated dams. Approximately 20 percent of the inundation studies on all Reclamation dams were completed during 1983, bringing the total of completed studies to 60 percent. Completion of inundation studies is scheduled for FY 1985.

Palisades Dam, Idaho, was one of the dams on which SEED investigations were conducted in FY 1983.

Acreage Limitation

The Reclamation Reform Act, which was signed into law by President Reagan on October 12, 1982, introduces a new concept to the Reclamation program. It permits an increase in the ownership

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entitlement from 160 acres to 960 acres for a qualified recipient (an individual, family, or legal entity established under State or Federal law which benefits 25 or fewer persons) and to 640 acres for a limited recipient (a legal entity established under State or Federal law benefiting more than 25 persons). The new law places no limit on the quantity of land that can be leased; however, it does limit the quantity of land in a farm operation that can receive low-cost irrigation water from a Reclamation project. A qualified recipient must pay full cost for water delivered to leased land in excess of 960 acres. A limited recipient must pay full cost for water delivered to land in excess of 320 acres if it received water before October 1, 1981, and full cost for water delivered to all land if it did not receive irrigation water before that date.

Shortly after the Reclamation Reform Act was signed into law, Reclamation began developing comprehensive rules and regulations for its implementation. Initial rulemaking activities included soliciting comments and suggestions from the public for content and format of the proposed rules; studying and preparing recommendations for specific provisions of the rules by Bureau work groups; and writing interim guidelines to establish procedures to be used to comply with the new law until final rules and regulations are published.

After an extensive review of all comments and suggestions, proposed rules were written and published in the *Federal Register* on May 3, 1983. In addition, a draft regulatory impact analysis, which assesses the potential economic effects of the proposed rules, was prepared. A draft environmental assessment and draft FONSI (Finding of No Significant Impact) were also prepared to address the environmental impacts of the proposed rules

From June 9 to June 24, 1983, 14 public hearings were held at locations throughout the West and in Washington, D.C. One hundred and fifty-two speakers gave testimony at these hearings expressing their views about the proposed rules. In addition, 119 documents were received through the mail during the comment period from May 3 to August 5, 1983. Approximately 1,500 specific comments about various provisions in the proposed rules were contained in written documents and transcripts of the hearings.

Public hearing on proposed rules for implementation of the Reclamation Reform Act held in Golden, Colorado.

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All comments and suggestions were carefully reviewed and the proposed rules were revised, taking into consideration generally voiced concerns. The final rules and regulations will be published in the *Federal Register* in late 1983. At that time, the final regulatory impact analysis, environmental assessment, and FONSI also will be available. The rules will become effective 30 days after publication in the *Federal Register*.

Land Resources Management

In connection with Reclamation's goal to improve management of land resources under its jurisdiction, plans were finalized for the initiation of a continuous inventory of all uses made of Reclamation lands. The inventory will be conducted in 5-year cycles, with every acre being inventoried at least once every 5 years. As part of Reclamation's ongoing annual land management and utilization review program, the Bureau identified 29 parcels comprising 532,413 acres of public domain lands and 16 parcels comprising 489 acres of acquired lands that are no longer needed for project purposes. These lands are reported to the Bureau of Land Management and General Services Administration, respectively, for decisions regarding eventual disposal or retention of the land in the Federal inventory.

To assist in the storage and retrieval of land use inventory information and to enhance the Bureau's ability to meet its accountability responsibilities for the real property it manages, work was begun on developing an automated Bureau-wide land records system. This data processing system will provide a uniform source for complete and current information on the extent, management, and use of federally owned real property from which accurate reports can be generated as required by the Congress and other agencies of Government.

Power Operation and Maintenance

The Power O&M program aims at optimizing the use of water resources for generation of hydroelectric power within established priorities for water use and storage.

The objective of the operations program is reliable, economical, and efficient operation of Reclamation's 50 hydroelectric powerplants, 1 wind farm, and 12 large pumping plants. Reclamation uses a preventive maintenance program for its facilities to maximize trouble-free operation at minimum cost. Included in these activities during FY 1983 were major electrical equipment testing, turbine seal ring replacement and modifications at one powerplant, two generator rewindings, two generator core replacements, and five generator upratings. The upratings resulted in a total increase of 69 megawatts of capacity.

The major equipment testing programs continued, including gas-in-oil analysis of insulating oils, Doble testing, and high-voltage direct-current testing.

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Foreign Activities

With the U.S. Government's commitment to assist the developing nations of the world, Reclamation increased its efforts to provide the necessary expertise in land and water resource development in 1983. Requests for technical assistance and training from international agencies and foreign governments showed a marked increase in spite of the worldwide economic problems. New programs in Israel, Sudan, Pakistan, Brazil, Somalia, and Ecuador were in the formulation and negotiation phase. These programs are designed for maximum participation by the U.S. private sector and to promote the sale of U.S. goods and services.

Technical Assistance

Short-term technical assistance within the broad spectrum of Reclamation's expertise was furnished in 1983 to the following nations: Arab Emirates, Peoples Republic of China, Columbia, Egypt, Ethiopia, India, Israel, Korea, Pakistan, Philippines, Saudi Arabia, Spain/Canary Islands, Sudan, Turkey, Yemen, and Zaire. Assignments ranged from 1 week to a maximum of 90 days. Since Reclamation receives no appropriated funds for international activities, these assignments were fully reimbursed by the host government or sponsoring international agency.

In addition to the short-term activities, long-term assistance programs continued in the host countries of Egypt, Israel, Malaysia, Saudi Arabia, and Zaire.

In Egypt, Reclamation provided technical expertise to the Egyptian Electrical Authority in the rehabilitation and modernization of the Aswan High Dam power system. Funding was received through AID (Agency for International Development), with the principal contracts awarded to U.S. firms and monitored by Reclamation.

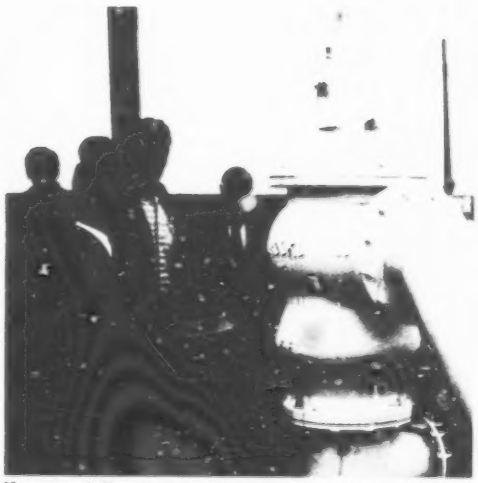
Reclamation also continued assistance to the Egyptian Ministry of Irrigation in developing a National Water Plan for the Nile's expansive system. Firms of the U.S. private sector are also actively participating in land reclamation on the Nile's broad irrigated delta.

Under an AID agreement, Reclamation provided technical assistance to the Government of Israel in developing an advanced desalination technology for worldwide application. The prototype plant, using a multieffect, low temperature distillation process, was completed in FY 1983. Data on operation of the plant are being collected to complete the technology transfer process.

In Malaysia, final design work was completed on Batu Dam, a major feature of the Kuala Lumpur Flood Control program. As funds become available, Reclamation advisors will assist with the construction supervision.

Assistance to Saudi Arabia, one of Reclamation's largest overseas programs, continued to increase throughout the year. Efforts are now directed in two major areas: land and water development and desalination of water for potable purposes. As part of the latter program, a large research, development, and training center is presently under construction at Al Jubail on the Arabian Gulf. Completion and staffing of this modern research facility is scheduled for 1984.

Reclamation's foreign assistance program in Zaire is now in its 10th year and final phase. The 1,700-kilometer extra high voltage direct-current transmission line is now operational and undergoing critical loading and checkout. As the local staff becomes self-sufficient in the line operation and maintenance, Reclamation's assistance program will be phased out.



Korean visitors view deep well pumping facilities, Central Valley Project, California.

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Training

More than 300 official visitors representing 47 countries visited the E&R Center and Bureau field installations during 1983. An additional 74 engineers, scientists, and administrators from 18 countries completed training programs tailored to their needs.

A new 1-week training course, "Seminar on Safety Evaluation of Existing Dams for Foreign Engineers," was presented to 32 engineers from 12 countries in 1983. During the first 3 days, numerous staff specialists presented lectures to the attendees at the E&R Center in Denver, Colorado. The other 2 days were spent in onsite examinations of Hoover and Davis Dams.

Science and Technology

The Bureau of Reclamation serves as the implementing technical agency for several science and technology agreements between the United States and other countries.

Under the Treaty of Friendship and Cooperation, a cooperative program was instituted in 1978 between Reclamation and the Spanish Director General of Hydraulic Works. Entitled "Techniques for Planning, Developing and Managing Water Resources," this 5-year program included the following projects in 1983: irrigation management services, irrigation technology, automation of existing irrigation systems, hydrometry, weather modification, and water quality. During the past 5 years, the Bureau has received $2.8 million from the Department of State under an interagency agreement to carry out field activities and furnish specialized irrigation monitoring equipment from U.S. manufacturers. Under this same treaty, Reclamation is providing technical supervision and analysis for a cloud-seeding project to alleviate severe water shortages on the Grand Canary Island. A new 5-year program has been submitted for approval by the U.S./Spain Joint Committee for Science and Technology.

Trainees from Syria, Nepal, and Korea observe irrigation practices on the Colorado-Big Thompson Project.

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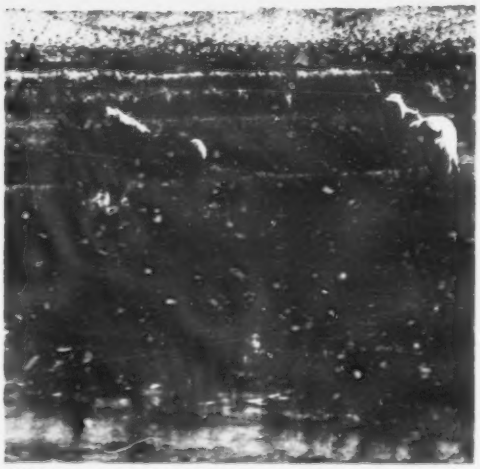
Environmental Enhancement

Ducks rise from dust abatement pond at Canyon Ferry Lake, Montana.



Wild horses on sandbars near the head of Lake Havasu, Arizona.

In the development and operation of multipurpose water resources projects by the Bureau of Reclamation, planning and implementing mitigation and enhancement features continue to be an important program goal.

In the Pacific Northwest, 10 goose-nesting platforms, 10 wood duck-nesting boxes, and 35 bluebird-nesting boxes were placed last fall in the Montour Wildlife Management Area just upstream from Black Canyon Reservoir, Idaho. Five of the 10 goose-nesting platforms were used this spring for nesting by Canada geese.

The Mid-Pacific Region began cooperative research on cultural practices required to establish drought-tolerant plants for poor soils exposed as a result of construction activities. Experimental planting began in 1969 and 1976 at two major damsites in northern California. Experience and criteria developed from this study will lead to successful vegetative reestablishment.

In California, over 7 miles of fencing to protect deer from entering the Tehama-Colusa Canal was installed in 1983. Antipredator fencing was installed at the Trinity River Fish Hatchery to keep out otters. Predators such as otters and herons have accounted for as much as 20 percent fish loss at the hatchery.

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Reclamation and the California Department of Water Resources coordinated their efforts to protect valuable riparian habitat located in the Arroyo Pasajero Siltation Basin. A State-Federal maintenance project to remove heavy silt buildup alongside the San Luis Canal will eliminate 27 acres of riparian habitat from the basin. An equal amount of basin land, also valuable riparian habitat but projected for agricultural leasing, will now be excluded from leasing and left undisturbed for wildlife use to make up for the lost habitat.

In the Lower Colorado Region, studies continued on how animal drownings can be avoided along proposed and existing canals and those under construction on the Central Arizona Project. Artificial oases and water catchments are being placed in different locations to see if the mammals will drink from them rather than the canals, thereby decreasing mammal mortality in the canals. Studies have also investigated the distribution and movement of desert mule deer and desert bighorn sheep along the Tucson and Granite Reef Aqueducts to determine what areas would be best used for oases, catchments, crossings, fencing, or escape devices. Escape ramps, ladders, and steps are also being studied on Mohawk Canal to determine their effectiveness. The results of this investigation will have Bureau-wide significance for lined canals with mammal mortality problems.

Reclamation is also cooperating in a multiagency effort to study the nesting population of bald eagles in central Arizona. The unique population of this endangered species may be affected by features of the Central Arizona Project Regulatory Storage Division. In an effort to determine the numbers and locations of the Yuma Clapper Rail, another endangered bird, Reclamation participated in potential habitat survey along the Lower Colorado River. Reclamation has taken the lead in producing a summary report for this interagency effort for the past 2 years.

A contract was awarded in August 1983 to determine the value of backwaters along the lower Colorado River. Past Reclamation actions to mitigate for impacts or enhance the environment have allowed for construction of some backwater areas. The study will evaluate existing "natural" and constructed backwaters on th river to see if they provide good fish and wildlife habitat.

In the Southwest Region, four cooperative investigations were conducted during 1983: a fishery management study and water quality study at Lake Texana, Palmetto Bend Project; a fishery management study at Choke Canyon Reservoir, Nueces River Project; and a trophic model development study for Caballo and Elephant Butte Reservoirs, Rio Grande Project. The region also initiated a riparian vegetation reestablishment program along the Rio Grande in association with the rehabilitation of the Rio Grande conveyance channel.

A new wildlife mitigation plan, based on replacing habitat unit values as measured by Habitat Evaluation Procedures rather than replacing acreage of affected habitat, was approved for the portions of the Garrison Diversion Unit, North Dakota, to be developed during the next 10 years. A supplemental environmental statement describing the new plan and other changes in the project was filed in July 1983. Approximately 3,475 acres in 13 tracts were purchased at a cost of $2 million in the final months of FY 1983. Several of the tracts were needed to "round out" mitigation areas previously acquired to make them more manageable. The tracts contain approximately 335 acres of wetlands and provide the opportunity to restore about 385 acres of wetlands that were previously drained.

Old tires will be submerged to provide a home for fish at Tom Steed Reservoir, Oklahoma.

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Cultural Resources

Kiva excavation in the McPhee archeology site, Dolores Project, Colorado.

Projectile point recovered from Sheep Skull Camp site, Dolores Archeological Program.

The protection of cultural resources continued to be a vital part of Reclamation's program in 1983. Activities covered all aspects of the Bureau's cultural resources program, including archeology, history, historic architecture, and paleontology.

Construction of a curation facility to house the thousands of artifacts and records from cultural resource studies related to construction on New Melones Dam, California, was completed in 1983. An interpretative booklet on the history of the town of Melones was prepared and will be printed in the near future.

In a joint project with the Bureau of Land Management, Reclamation supplied funds for interpretative signs along a trail leading to archeological sites and geological features at Grimes Point National Register District, near Fallon, Nevada.

The CAP (Central Arizona Project) is one of the largest and most complex projects that Reclamation has ever constructed. The cultural resources, both historical and archeological, affected by the project are correspondingly rich and complex. The nearly 400 miles of aqueduct that will transport Colorado River water to users in Central Arizona and the associated storage and regulatory features will affect hundreds of archeological and historical sites. Reclamation already has an extensive survey and mitigation program in progress to fulfill its responsibilities for preserving and managing these cultural resources.

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In order to unify the cultural resource program for the entire CAP, a Cultural Resource Overview began in 1983. Because the locations of CAP facilities correspond closely with the territory of the Hohokam culture, the results of CAP-related archeological research is adding much to the knowledge of these ancient farming people. The overview will not only summarize much of our present knowledge of the area but will also develop an overall research strategy for the project, ensuring an integrated approach to fulfilling Reclamation's responsibilities, helping eliminate duplication of effort between project features, and producing a more effective program in terms of research and preservation.

The Dolores Archeological Program, Colorado, continued in FY 1983, with $1.7 million spent during this final year of fieldwork in the reservoir. The first publication from this project, dealing with the history of the project area, was released in the winter of 1983.

A Memorandum of Agreement for cultural resources on the Garrison Diversion Unit, Pick-Sloan Missouri Basin Program, was finalized. A contract for work on the Lonetree Reservoir area was awarded and fieldwork was completed by the end of the fiscal year. At a cost of $25,000, the initial work order included recordation of the "Winter Mud House," a German-Russian structure on the National Register of Historic Places.

An extensive occupation site was uncovered during topsoil removal for Safety of Dams work at Deerfield Reservoir, South Dakota. The site had been disturbed previously by agricultural and lumber activities and was recorded and tested at that time. This subsequent discovery resulted in the removal of at least 200 fire hearths and numerous lithic materials. Prehistoric occupation extends at least 8,000 years, up through the Late Prehistoric period. The site is important in that very little subsurface cultural investigations have been conducted in the Black Hills of South Dakota.

Under a cooperative agreement between Reclamation and the Wyoming State Archeologist, test excavations were made at the McKean Site, Keyhole Reservoir, Wyoming. This site has been subject to extreme erosion by the reservoir and overuse by recreationists. Tests indicate that a great deal of the site still exists, and the Bureau will limit public access to the area. Laboratory analysis and the report will be prepared during FY 1984. Total Bureau cost is $30,000; Wyoming's share is about $24,000.

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Job Corps

Corpsmembers from metal-working class put railing on steps of dining hall at Marsing Job Corps Center.

Weber Basin Center corpsmembers learn cement masonry skills.

Reclamation has been involved in the Job Corps program since its establishment by the Economic Opportunity Act of 1964.

During FY 1983, a total of 849 corpsmembers were enrolled at Reclamation Job Corps Civilian Conservation Centers located in Marsing, Idaho; Moses Lake, Washington; Collbran, Colorado; and Ogden, Utah. Once an all-male program, the Job Corps began enrolling female corpsmembers in 1981, and in 1982 approximately 110 women participated in the program.

The main purposes of the Job Corps are to teach disadvantaged youths between the ages of 16 and 21 a vocational trade, to improve their education level to enable them to qualify for a General Education Development Certificate, and to develop their social skills and values. Training is acquired in both union and nonunion trades. Union trades include bricklaying, heavy equipment operation and repair, carpentry, painting, cement masonry, tile setting, and plastering. Nonunion trades include welding, automobile mechanics, building and custodial maintenance, cooking and baking, warehouse, clerical, and medical assistant skills. After training, corpsmembers are assisted in obtaining jobs within their communities.

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Corpsmembers spend comparable time in vocational training and basic education classes. The education classes include mathematics, reading and writing skills, driver education, physical education, and health. In addition to improving their educational levels, these courses are structured for practical application in vocational skills training and in the workaday world.

Corpsmembers live at civilian conservation centers where they learn how to interact, develop good work and study habits, develop leadership, pursue hobbies, learn vocational skills, and engage in sports. The objective is to provide these youths with meaningful and enriching experiences and to encourage them to be useful and productive citizens.

The Job Corps Civilian Conservation Centers program not only provides opportunities for personal development for its corpsmembers, it also produces valuable projects for the Bureau, other Federal or State agencies, local communities, and for the centers themselves. Typical projects include construction of buildings, roads, recreation facilities, and small earth dams; landscaping; and numerous maintenance projects. During FY 1983, 2,450 corpsmember-months were expended on construction projects. At a direct materials cost of $806,500, the value of the projects was appraised at $4 million.

Weber Basin Job Corps Civilian Conservation Center, Ogden, Utah.

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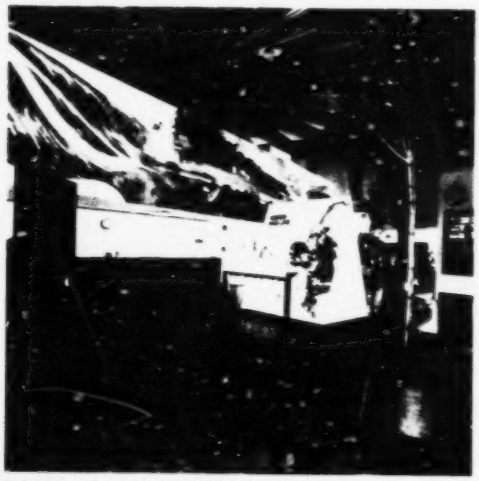
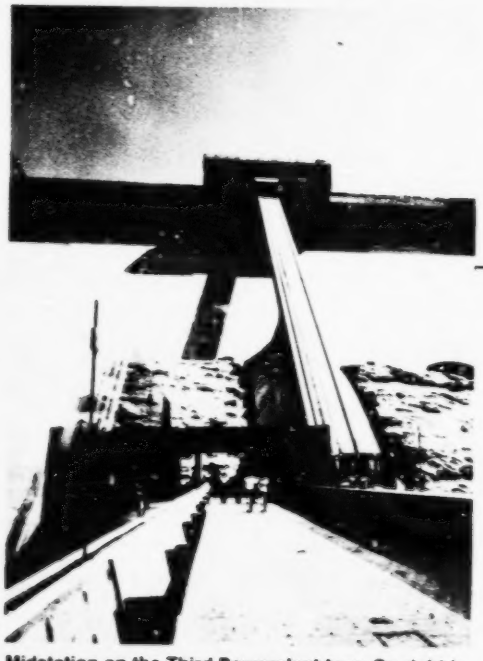
Grand Coulee Dam...

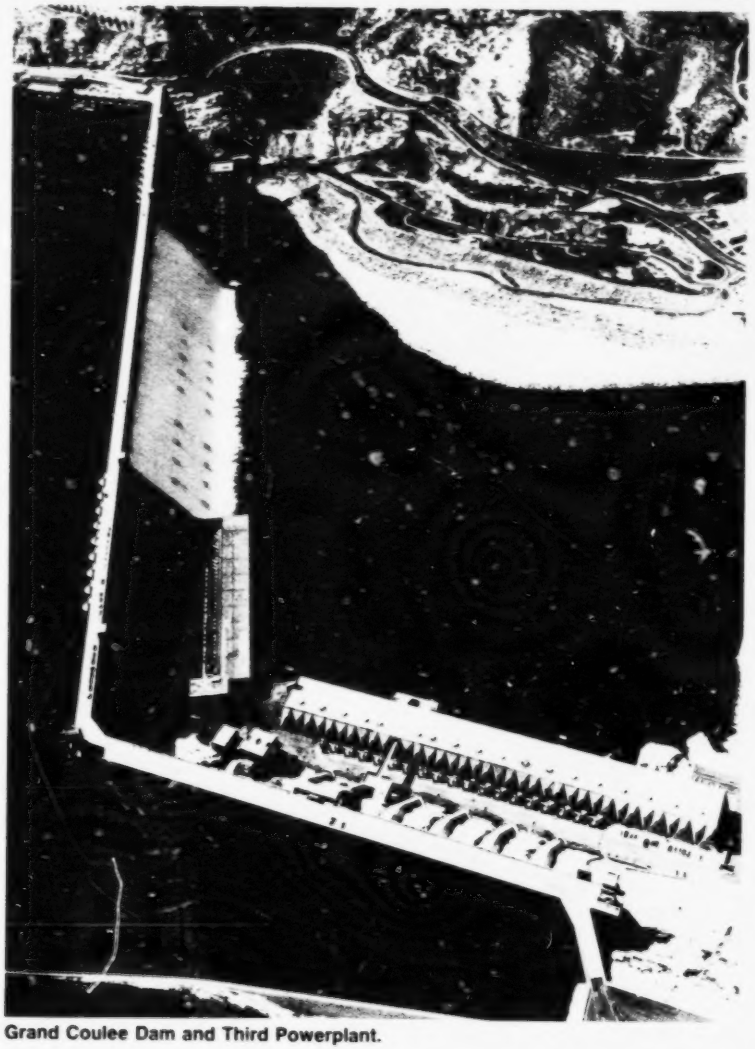
Celebrating Its 50th



Interior view of the visitor arrival center.



Midstation on the Third Powerplant tour. On right is elevator to the top of the dam.



Grand Coulee Dam and Third Powerplant.

On July 16, 1933, the first shovel of earth was turned for the biggest dam in the world — Grand Coulee Dam.

Exactly 50 years later, dignitaries and visitors gathered to commemorate the golden anniversary of this giant concrete structure — still one of the biggest dams in the world — and to dedicate its Third Powerplant and new visitor facilities. Located on the Columbia River about 90 miles west of Spokane, Washington, Grand Coulee Dam is the key feature of Reclamation's multipurpose Columbia Basin Project.

Five aerial bombs, one for each decade since the 1933 groundbreaking ceremony, burst high above more than 5,000 people as the celebration began. Entitled "Water and Life — Celebrating the First 50 Years of the Columbia Basin Project," the weekend of festivities included a barbecue, fireworks, entertainment, arts and crafts, and many other activities. Secretary of the Interior James G. Watt was the principal speaker on the program.

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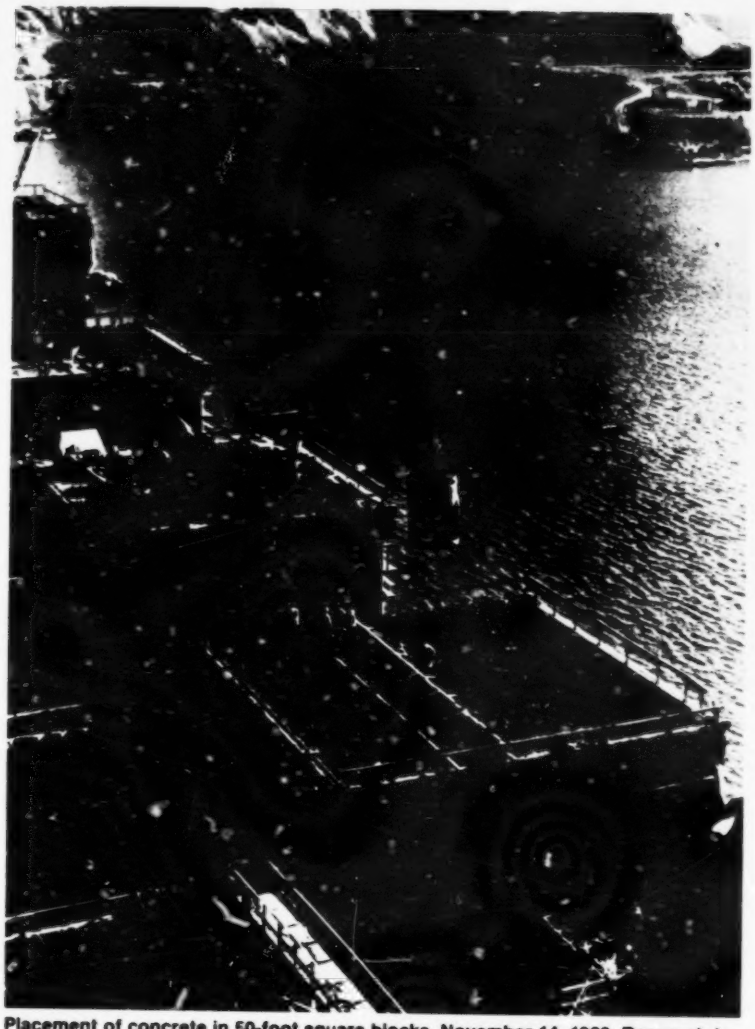
Grand Coulee Dam was completed in 1942. A pumping plant lifts water from the Columbia River into a high, 26-mile-long dry riverbed formed when the Columbia was forced from its original bed by a glacier during the Ice Age. The river eventually returned to its original bed, leaving the newer bed — the Grand Coulee — high and dry above the Columbia. The dam creates Franklin D. Roosevelt Lake, a huge reservoir with a storage capacity of 9.5 million acre-feet of water . . . water to generate electricity, grow crops, and provide recreation opportunities. Operation of the dam also provides flood control and river regulation. Construction of the project provided work for thousands of jobless during the Great Depression of the 1930's. Irrigation facilities were built after World War II and work is still continuing on several features of the Columbia Basin Project.

The Nation's largest producer of hydroelectric power, Grand Coulee is also the largest single hydroelectric-generating complex in the world. Its three powerplants, with a total installed capacity of nearly

Spring runoff spills through the blocks on May 23, 1939.

Franklin D. Roosevelt observes construction progress during his second visit to Grand Coulee Dam in 1937.



Placement of concrete in 50-foot square blocks, November 14, 1939. Reservoir in the background eventually became Franklin D. Roosevelt Lake.

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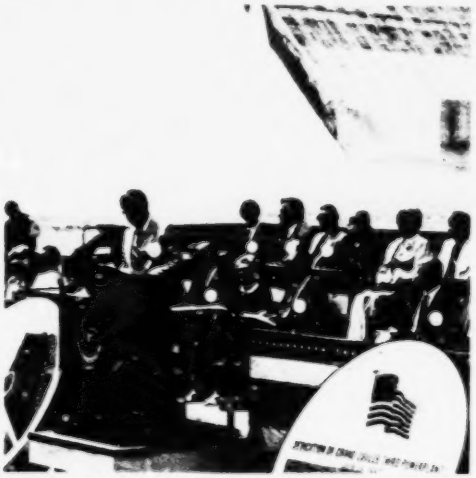
Ceremonial first bucket of concrete for the Third Powerplant is lowered.



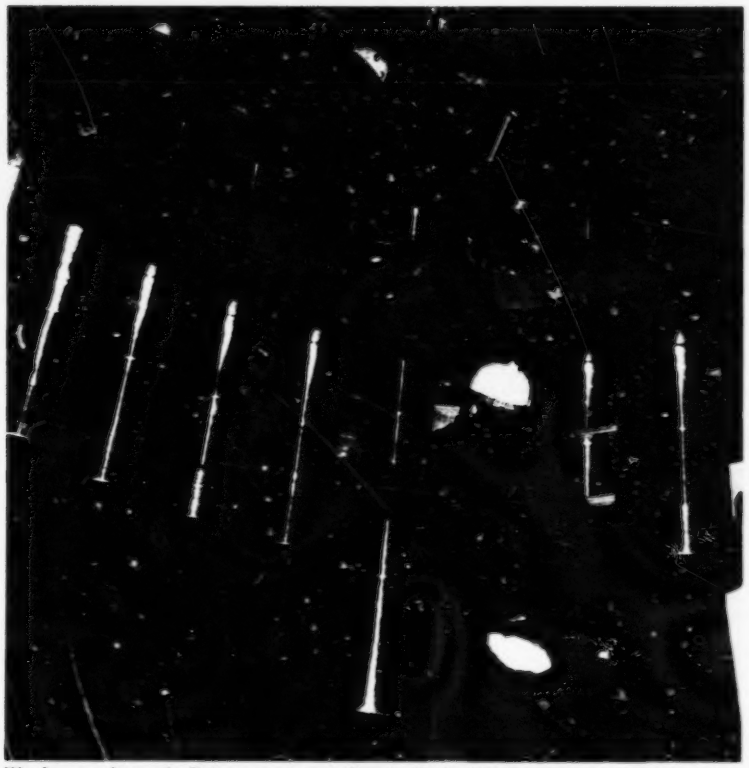
Commissioner Broadbent and dignitaries at 50th anniversary celebration.

6.3 million kilowatts, generated over 23.3 billion kilowatt hours of energy in 1982. The Third Powerplant Forebay was designed so that it can accommodate additional units which, if found feasible, could further increase generating capacity. The power produced at Grand Coulee is distributed and marketed throughout the Pacific Northwest by the Bonneville Power Administration.

The Columbia Basin Project was designed and authorized by the Congress to ultimately irrigate 1.1 million acres. In 1982, over 2 million acre-feet of agricultural water were delivered to nearly 544,000 acres of land. Crops grown on project lands have accumulated a gross value of $3.6 billion since 1948, when irrigation deliveries began. Over 60 different crops are grown on the Columbia Basin Project. Food and livestock production industries have flourished as a result of the availability of these diverse crops. These industries have contributed tremendously to economic growth in the Pacific Northwest. The project also delivers water for municipal and industrial and other nonagricultural uses. Expansion of the project to its ultimate capacity is currently underway.

The Columbia Basin Project also provides recreation opportunities that attract over 2 million visitors annually. Grand Coulee Dam, itself, is a major tourist attraction. Almost 64,000 people toured the dam and powerplant in 1982.

Another major benefit of the dam is the flood control it provides. Cumulative flood control benefits realized from operation of the dam since 1950, when records were first kept, amounted to $161.7 million in 1982.



Workmen place shaft-to-runner coupling bolts inside the runner, a part of the turbine unit. The nuts for these giant bolts weigh 135 pounds each.

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Colorado River Basin Operations 1983

Morrow Point Dam, Colorado, Reclamation's first thin-arch double curvature dam, spills in June during 1983 high water runoff period.

For one of the few times in its history, water was let through the 96-inch-diameter outlet pipes at Glen Canyon Dam due to the high water in the Colorado River Storage System.

The Colorado River threw operations personnel a "fast curve" during the 1983 runoff season. On March 1, the April-July inflow forecast to Lake Powell was 6.7 million acre-feet (96 percent of normal), and as late as June 1 it was about 9.1 million acre-feet (130 percent of normal). On June 22, however, the forecast jumped to 14.6 million acre-feet (210 percent of normal), the highest inflow since 1920. This near record inflow occurred in a short period of time and attained a peak of 116,000 ft^3/s on June 28.

This inflow, coupled with restricted spillway capacity at Glen Canyon Dam due to structural damage to the spillway, required unique

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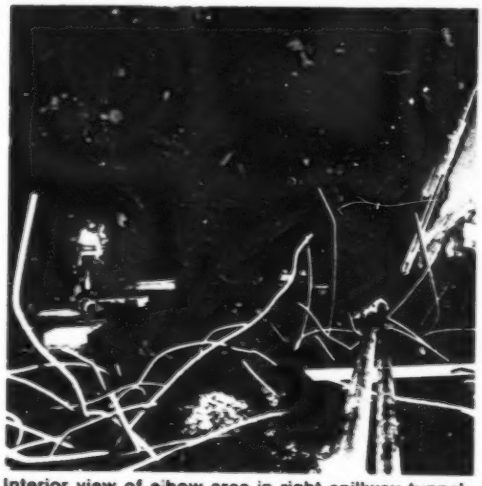

Interior view of elbow area in right spillway tunnel at Glen Canyon Dam, where extensive erosion occurred during spring runoff.

operational measures to be undertaken. For example, 8-foot metal flashboards were added atop the four spillway gates at Glen Canyon Dam to increase the capacity of Lake Powell by 1.3 million acre-feet. Despite these measures, releases up to 92,000 ft^3/s (about three times normal) were required to route the high inflows through the dam.

What caused these unusually high flows into Lake Powell was a freak alinement of circumstances that, when combined, caused such an abnormal year that no prediction model could have forecast its outcome. These circumstances were:

- Heavy rainfall in the fall of 1982, which contributed toward saturation of the soil in the watershed
- Extremely heavy snowfall in late April and May of 1983, which is uncommonly late in the season
- Unusually cold temperatures, which prevented the snow from melting slowly over a longer period of time and reduced the amount of evaporation that normally takes place

Aerial view of Lake Powell and Glen Canyon Dam, Arizona-Utah.

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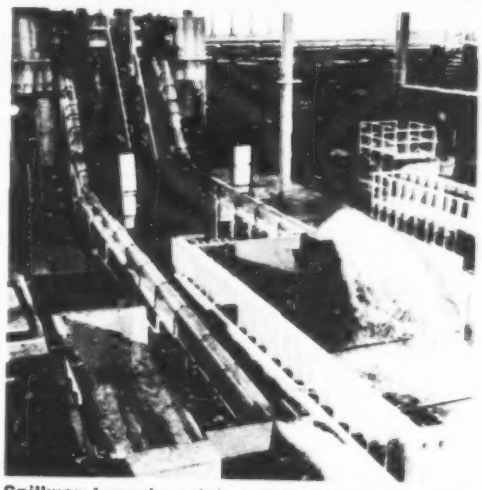
- A sudden hot spell in early June, causing the snow to melt quickly in large amounts

Damage to both the right and left spillways at Glen Canyon Dam was considerable. The tremendous force of the rushing water eroded about 2,500 cubic yards of concrete lining from the conduits and ate deep into the sandstone beneath. Repair work, which started shortly after peak flows subsided, consists of replacement of concrete in the eroded areas and installation of air slots in the spillways. The air slots will prevent a recurrence of this situation by improving the flow of water in the spillways. Placement and configuration of the air slots were determined by means of a model tested in the Engineering and Research Laboratory in Denver, Colorado. Other Reclamation dams with similar spillways, including Hoover Dam, will also have air slots installed to prevent such damage in the future.

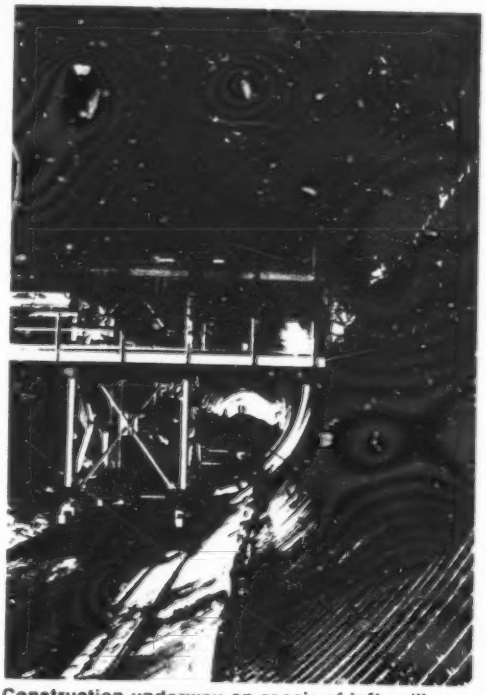
Record releases from Glen Canyon obviously created problems downstream at Hoover, Davis, and Parker Dams. The goal of the operating plan during the high runoff period was to limit flows to about 40,000 ft^3/s, the planned floodway capacity below Davis and Parker Dams. This goal was achieved; however, over the past 20 years channel degradation and encroachment of development into the floodway have reduced the safe channel capacity to the point where in some areas flood damage now occurs at flows of approximately 22,500 ft^3/s. Therefore, while releases were maintained at about 40,000 ft^3/s, considerable flood damage occurred to residential, agricultural, and recreational areas located *inside* the levee system within the floodway.

Lake Mead storage reached the top of the raised spillway gates (elevation 1221.40) on July 3, creating the first spill at Hoover Dam since test releases were made in 1941. Relatively minor spillway damage also occurred in the Nevada spillway conduit. The reservoir storage crested at an elevation of 1225.83 feet on July 25. The operating plan after peak inflows subsided consisted of minimizing flow levels on the Lower Colorado River downstream from Hoover Dam by using the high surcharge levels in the upstream reservoirs. Gradual reductions in release levels were started in mid-October to attain nondamaging levels in about mid-November.

These record flows affected many people living adjacent to the Colorado River below Glen Canyon Dam and others such as recreationists. Efforts were made by Bureau personnel to inform all those affected as early as possible in order to minimize inconvenience, risk, and damage. It should be noted that while the peak inflow to Lake Powell was 116,000 ft^3/s, this flow was attenuated to a peak of about 40,000 ft^3/s below Hoover, Davis, and Parker Dams, thus greatly reducing flood damages.



Spillway tunnel model used to develop air slot design.



Construction underway on repair of left spillway tunnel at Glen Canyon Dam.

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Status of Funds

United States
Department of the Interior
Bureau of Reclamation

FY 1983 Status of Funds

	Available Funds*	Obligations	Expenditures
		($ million)	
General Investigations	39.6	33.9	35.7
Construction	828.2	770.5	625.2
Operation and Maintenance	157.2	153.5	139.3
Loan Program	58.3	55.5	32.8
Emergency Funds	4.5	0.9	0.6
General Administrative Expense	40.7	40.7	40.1
Total FY 1983	1,128.5	1,055.0	873.7

* 1983 appropriation plus prior year and other available funds.

Definitions:

An appropriation is legal authorization to incur obligations and make payments for specified purposes.

An obligation is binding commitment to pay out money for products, services, or other purposes.

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